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## DEPARTMENTS.

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### SOLUTIONS OF PROBLEMS.

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#### ALGEBRA.

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**254.** Proposed by R. D. CARMICHAEL, Hartselle, Ala.

Sum to infinity the series  $\frac{n^2}{(16n^2-1)^2}$  beginning with  $n=1$ .

Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

$$\begin{aligned} \sum_{n=1}^{\infty} \frac{n^2}{(16n^2-1)^2} &= \frac{1}{64} \sum \left[ \frac{1}{(4n^2-1)^2} + \frac{1}{4n-1} - \frac{1}{4n+1} + \frac{1}{(4n-1)^2} \right] \\ &= \frac{1}{64} \left[ \left( \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \frac{1}{9^2} \dots \right) + \left( \frac{1}{3} - \frac{1}{5} + \frac{1}{7} - \frac{1}{9} \dots \right) \right] \\ &= \frac{1}{64} \left[ \left( \frac{\pi^2}{8} - 1 \right) + \left( 1 - \frac{\pi}{4} \right) \right] = \frac{1}{64} \left( \frac{\pi^2}{8} - \frac{\pi}{4} \right). \end{aligned}$$

Also solved by G. W. Greenwood.

**255.** Proposed by O. E. GLENN, Ph. D., Springfield, Mo.

Let  $f$  be the binary cubic  $a_0x_1^3 + 3a_1x_1^2x_2 + 3a_2x_1x_2^2 + a_3x_2^3$ ,  $\Delta = (f, f)_2$  the covariant, the second transvectant of  $f$  over itself, and  $R = 2[4(a_0a_2 - a_1^2) \times (a_1a_3 - a_2^2) - (a_0a_3 - a_1a_2)^2] = (\Delta, \Delta)_2$  = the second transvectant of  $\Delta$  over itself. Then if  $\Delta_{\kappa\lambda}$  is the  $\Delta$  covariant for the cubic pencil  $\kappa f + \lambda Q$ ,  $Q$  being the first transvectant of  $f$  over  $\Delta$  we have  $\Delta_{\kappa\lambda} = (\kappa^2 - \frac{1}{2}\lambda^2 R)\Delta$ .

Solution by G. W. GREENWOOD, M. A., McKendree College, Lebanon, Ill.

If  $R \neq 0$ , we may reduce the quantic to the form  $mX^3 + nY^3$ . Hence,  $\Delta = 2mnXY$ ,  $R = -2m^2n^2$ ,  $Q = m^2nX^3 - mn^2Y^3$ ,

$$\begin{aligned} \kappa f + \lambda Q &= (\kappa m + \lambda m^2 n) X^3 + (\kappa n - \lambda m n^2) Y^3, \\ \text{and } \Delta_{\kappa\lambda} &= 2mn(\kappa^2 - \lambda^2 m^2 n^2) XY = (\kappa^2 - \frac{1}{2}\lambda^2 R)\Delta. \end{aligned}$$

If  $R = 0$ , we may reduce the quantic to the form  $3lX^2Y$ . Then  $\Delta = -2l^2X^2$ ,  $Q = 2l^3X^3$ ,  $\kappa f + \lambda Q = 3\kappa lX^2Y + 2l^3\lambda X^3$ . Hence  $\Delta_{\kappa\lambda} = -2\kappa^2 l^2 X^2 = \kappa^2 \Delta$ .

Also solved by M. E. Gruber.